Non-CO$_2$ Greenhouse Gases: Methane

Source/Sectors: Natural Gas Systems (Production; Processing; Transmission)

Technology: Automated air/fuel ratio controls (A.1.2.1.15; A.1.2.3.13)

Description of the Technology:
In the United States and worldwide, many efforts have been made to identify and implement mitigation options to reduce methane emissions from the natural gas sector (USEPA, 2003). For example, the Natural Gas STAR program is a voluntary partnership between US EPA and the oil and gas industry to identify and implement cost-effective technologies and measures to reduce methane emissions. The measures to reduce methane emissions from the natural gas systems can be grouped into the following mitigation strategies: prevention, recovery and re-injection, recovery and utilization, and recovery and incineration (Hendriks & de Jager, 2001).

Natural gas-fueled internal combustion engines can provide continuous duty operations over a set range of air to fuel ratios (AFR). Fuel-rich conditions result in greater unburned fuel emissions (primarily methane) and higher CO emissions. Fuel savings and reduced associated emissions can be achieved by installing an automated AFR control system (USEPA, 2004).

Effectiveness: Good

Implementability: The greatest opportunities for system and efficiency improvements are on rich burn, high-speed, turbocharged engines (1,000 hp to 3,000 hp).

Reliability: Good. It was found that operators, in general, run engines in a rich-AFR state would provide the most reliability for field operations (USEPA, 2008).

Maturity: Good

Environmental Benefits: A partner of the Gas STAR program has reduced its fuel consumption by 18% to 24% by installing automated AFR controls on 51 selected engines in its Gulf of Mexico operations. It achieved an average emission reduction of 128 Mcf of methane per unit per year by reducing the engines' fuel consumption (USEPA, 2008).

Cost Effectiveness: A partner of the Gas STAR program reported a reduction in fuel consumption in excess of 2,900 MMcf during a two-year period as the result of installing the REMVue technology on 51 engines, or an average of 78 Mcf per day per engine when adjusted for load. This represents a 39 percent increase in estimated fuel savings (based upon a sample inventory, which yielded a pre-job fuel savings estimate of 56 Mcf per day). The total reported cost was $6.1 million. Capital costs, including installation, ranged from $85,000 to $140,000 per unit, with the average cost for the last two years being $120,000 per installation. At a nominal value of $3 per Mcf, the fuel savings was more than $4.35 million for a calculated payout of 1.4 years (USEPA, 2008).

The partner found that the additional cost of operating the REMVue systems is offset by the reduction in engine maintenance costs. A reduction in NO$_x$ and CO$_2$ emissions are an added benefit of the system. A post-audit was conducted on 20 percent of the installed base in 2004. Among the engines that were revisited, there were some that were retrofitted as early as 2001. The post audit reviewed pre-, post- and post-post-values for fuel consumption, emissions reductions, availability, and economics based on a normalized gas price. The emissions reduction results showed that unburned hydrocarbons were down 3,549 tons per year, CO$_2$ emissions were down 2,309 tons per year, and CO

emissions were down 83,300 tons per year. There were no changes in NOx emissions. Availability increased 2.25 percent for the 12 months pre-installation versus 12 months post-installation.

- Capital Costs (including installation) : >$10,000
- Operating and Maintenance Costs (annual): Installing system reduces maintenance costs
- Payback (Years): 1-3

Industry Acceptance Level: ChevronTexaco

Limitations: None reported. The technology can communicate/interface with most existing electronic control and telemetry systems.

Sources of Information:
1. California Energy Commission (2005) "Emission Reduction Opportunities for Non-CO_2 Greenhouse Gases in California", a report prepared by ICF Consulting for California Energy Commissions, CEC-500-2005-121, July 2005.
2. Hendriks, C.; de Jager, D. (2001) "Economic Evaluation of Methane Emission Reductions in the Extraction, Transport and Distribution of Fossil Fuels in the EU: Bottom-up Analysis", A final report to European Commission.
3. International Energy Agency (2003) "Building the Cost Curves for the Industrial Sources of Non-CO_2 Greenhouse Gases", Report Number PH4/25, IEA Greenhouse Gas R&D Programme, Cheltenham, United Kingdom, October 2003.
4. International Energy Agency (2003) "Building the Cost Curves for the Industrial Sources of Non-CO_2 Greenhouse Gases", Report Number PH4/25, IEA Greenhouse Gas R&D Programme, Cheltenham, United Kingdom, October 2003.
5. International Energy Agency (2003) "Building the Cost Curves for the Industrial Sources of Non-CO_2 Greenhouse Gases", Report Number PH4/25, IEA Greenhouse Gas R&D Programme, Cheltenham, United Kingdom, October 2003.
6. U.S. Climate Change Technology Program (2005) "Technology Options for the Near and Long Term", U.S. Department of Energy, http://www.climatetechnology.gov/index.htm, August 2005.
7. U.S. Environmental Protection Agency (2003) "International Analysis of Methane and Nitrous Oxide Abatement Opportunities: Report to Energy Modeling Forum, Working Group 21", a report prepared by ICF Consulting for the United States Environmental Protection Agency.
8. U.S. Environmental Protection Agency (2004) "International Methane and Nitrous Oxide Emissions and Mitigation Data", United States Environmental Protection Agency. Available online at www.epa.gov/methane/appendices.html (in Excel file).
9. U.S. Environmental Protection Agency (2008), Natural Gas Star Program, http://www.epa.gov/gasstar/index.htm, U.S. EPA, Washington DC, 2004.